

# (12) UK Patent Application (19) GB (11) 2 142 591 A

(43) Application published 23 Jan 1985

(21) Application No 8317314

(22) Date of filing 25 Jun 1983

(71) Applicant  
Armstrong Competition Motorcycles Limited,  
(United Kingdom),  
Gibson Lane, Melton, North Ferriby,  
North Humberside HU14 3HY

(72) Inventors  
Barry Charles Hart,  
John Michael Eatough

(74) Agent and/or Address for Service  
W. P. Thompson & Co.,  
Coopers Building, Church Street, Liverpool L1 3AB

(51) INT CL<sup>3</sup>  
B62K 25/04

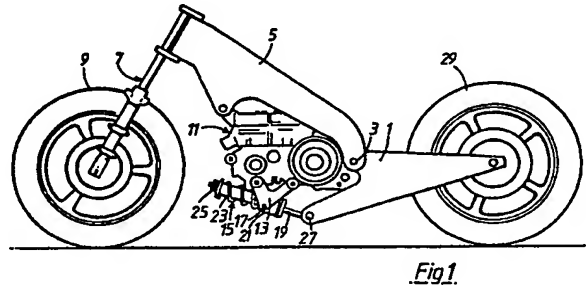
(52) Domestic classification  
B7E CS

(56) Documents cited  
None

(58) Field of search  
B7E

## (54) Motorcycle rear wheel suspension

(57) A rear suspension which is light and has a low centre of gravity comprises a shock absorber and spring unit (15) which is mounted to the engine (11) so as to be pivotal about its middle region (17), the engine (11) being mounted on a main part (5) of the motorcycle frame (5,1). One end region (19) of the shock absorber and spring unit (15) is pivotally secured (27) to a rear swing arm (1) of the frame (1), at a point spaced from a pivotal connection (3) between the rear swing arm (1) and the main part (5) of the frame. The spacing between connections (3) and (27) provides for a variation in the mechanical advantage applied to the shock absorber/spring unit (15), providing an adjustment for different loads, speeds and terrains. Further the positioning of the unit (15) as low as possible aids the stability of the motorcycle.



The drawing(s) originally filed was (were) informal and the print here reproduced is taken from a later filed formal copy.  
The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1982.

GB 2 142 591 A

2142591

1/2

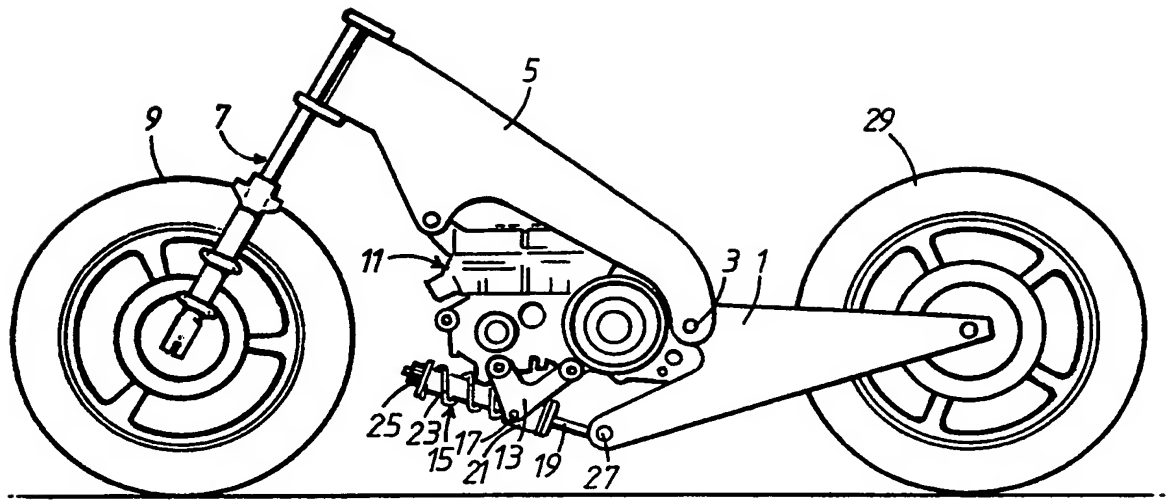


Fig 1

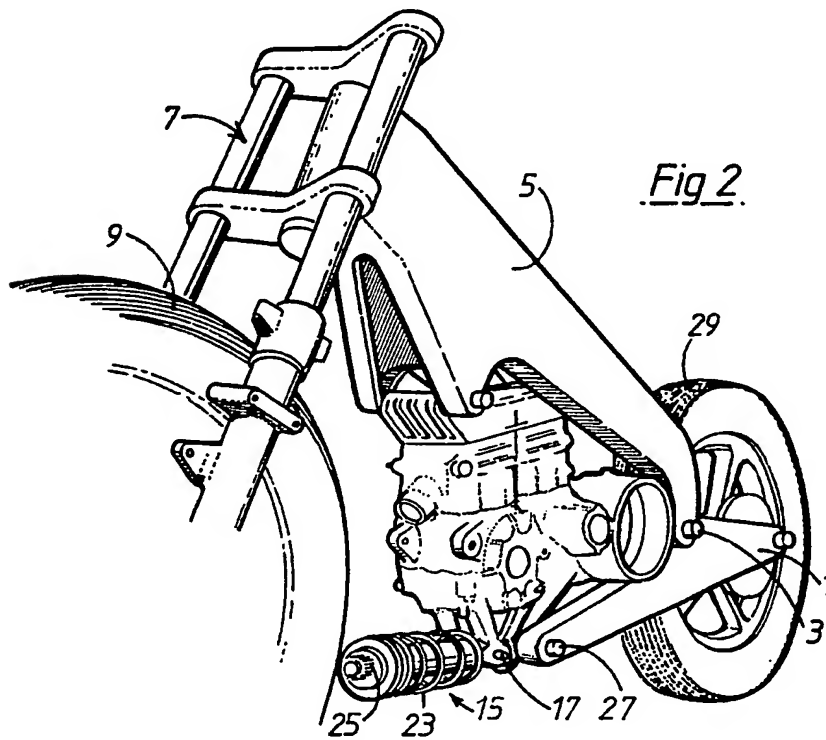
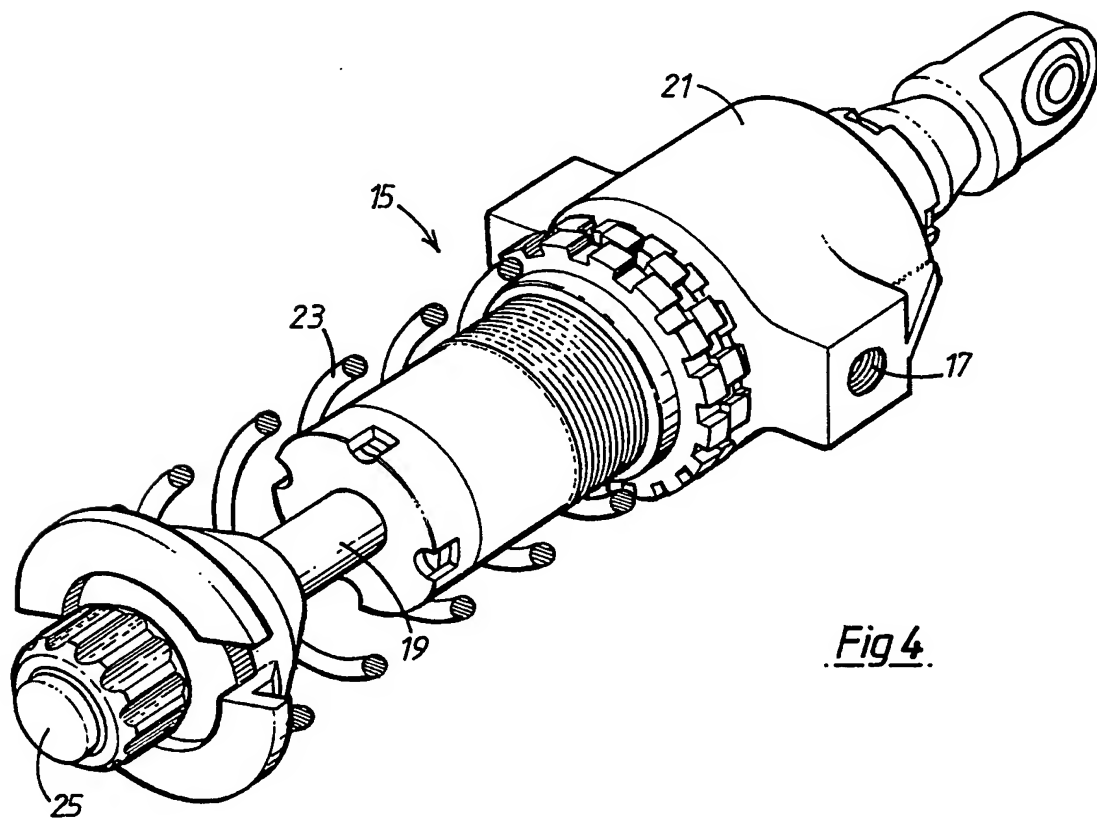
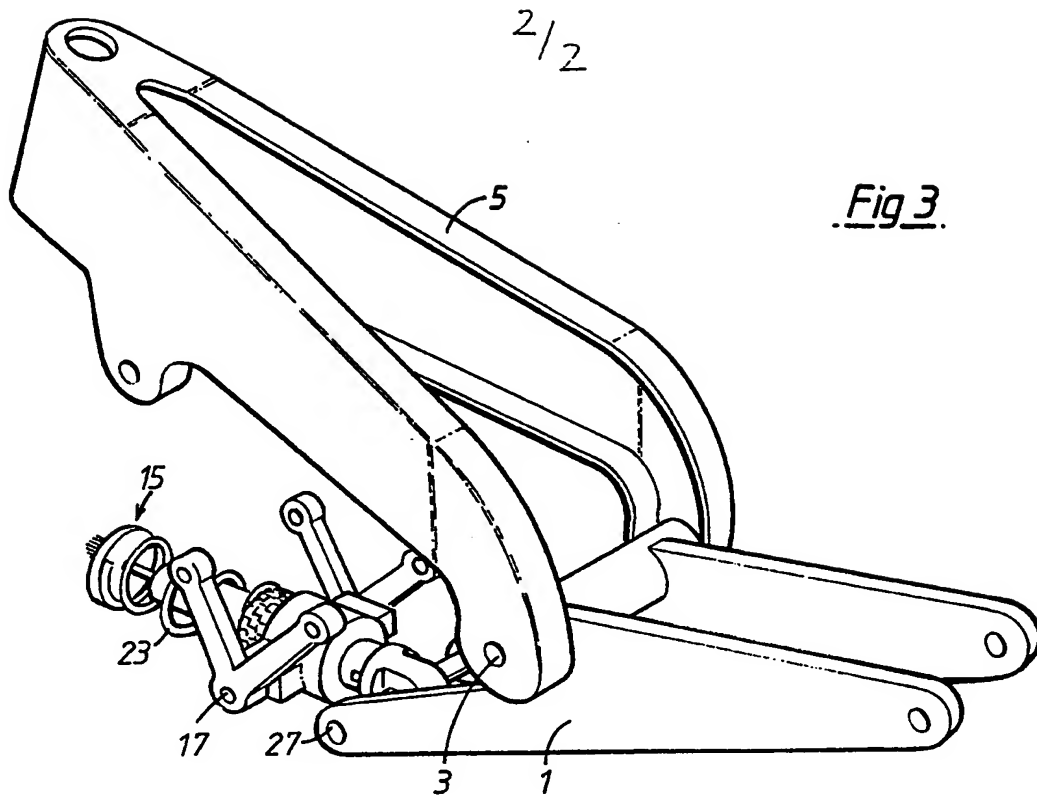


Fig 2

2142591



## SPECIFICATION

## Improvements relating to motorcycle suspension

- 5 The present invention relates to a motorcycle suspension system.

More particularly the present invention relates to a motorcycle rear suspension system. Conventionally the rear wheel of a motorcycle has been mounted on a motorcycle frame or chassis using springs and shock absorbers, usually telescopic shock absorbers. The springs and shock absorbers are selected for the particular type of use to which the motorcycle is to be used and whilst such selected springs and shock absorbers may, for example, provide a soft comfortable ride over normal surfaces for a light load, e.g. rider only, the ride characteristics change for the worse if the load is increased and/or the surface of the terrain becomes rough or severely undulating.

- 20 A relatively recent development in motorcycle rear suspension systems has provided an advantage of a progressive spring rate rise. This means that the motorcycle rear suspension provides a 'soft' comfortable ride over normal surfaces with a light load e.g. rider only, and also copes with more severe surfaces and situations such as pot holes, ramps etc with a heavier load e.g. passenger, luggage etc. This has been achieved by the introduction of a linkage or bell crank system between the rear wheel and the shock absorber/spring unit, which changes the mechanical advantage of the shock absorber/spring unit in relation to the wheel as the wheel is moved relative to the motorcycle frame. With a light load and/or normal surfaces, the mechanical advantage between rear wheel and shock absorber/spring unit, is low and a soft ride ensues. However, with a heavier load and/or rough surfaces the mechanical advantage increases to cope with the situation, providing a better ride and preventing bottoming of the unit.

Whilst the above rear suspension system operates satisfactorily, it has certain disadvantages. First of all it requires a number of extra components i.e. to provide the necessary linkages. This can be some-times as many as twelve extra components compared to a conventional rear suspension system. Clearly this adds to manufacturing costs and disadvantageously increases the weight of the motorcycle. Further, there is the problem of space inavailability for such a rear suspension system.

The aim of the present invention is to provide a relatively simple motorcycle rear suspension with all of the above described advantages but with at least a reduction in the above described problems and disadvantages.

According to the present invention there is provided a motorcycle rear suspension for a motorcycle having a frame comprising a rear swing arm which carries the rear wheel of the motorcycle, the rear swing arm being pivotally attached to a further part of the frame, the rear suspension comprising a shock absorber and spring unit which is fixedly mounted relative to said further part of the frame so as to be pivotal about its middle region, one end region of the shock absorber and spring unit being pivotally

secured to the rear swing arm at a point spaced from the pivotal connection between the rear swing arm and said further part of the motorcycle frame.

- By virtue of the present invention a single shock absorber and spring unit provides the required suspension for a rear wheel rotatably mounted on the rear swing arm. Further, as the shock absorber and spring unit is both pivoted about its middle region and pivotally connected to the rear swing arm at a point spaced from the pivotal connection between the rear swing arm and the said further part of the frame, the mechanical advantage i.e. lever ratio, between the rear wheel and the shock absorber and spring unit, will increase as the load on the motorcycle i.e. extra luggage or a rough terrain, increases. This is because, as the load increases the shock absorber and spring unit will pivot about its middle region, the angle between lines drawn between the pivot points for the shock absorber/spring unit and the two pivot points on the rear swing arm, tending towards 90°.

Preferably the shock absorber and spring unit is an integral assembly with the shock absorber being of the pull-push type wherein the piston rod passes completely through the unit. The spring is mounted on one projecting end region of the piston rod and is compressible between the body of the shock absorber and the free end of said one end region of the piston rod. The free end of the other projecting end region of the piston rod is pivotally connected to the rear swing arm.

Whilst the rear swing arm and said further part of the motorcycle frame may be made conventionally in the form of a tubular frame, preferably the frame sections or parts are made from moulded sections of carbon fibre. This maintains strength and considerably lightens the motorcycle frame.

In a preferred application of the present invention, the said further part of the motorcycle frame is the main part of the frame, and both this main part and the rear swing arm are moulded from carbon fibre. The engine is secured to this main part of the frame and the push-pull shock absorber/spring unit is mounted under the engine, thus lowering the centre of gravity of the machine.

Thus it will be appreciated that the present invention achieves the desired progressive spring rate rise without the complex linkages involved in existing systems. Thus weight and manufacturing costs are reduced, the problem of installation space availability is obviated, especially if the shock absorber and spring unit is fitted under the frame. Of course, if desired the shock absorber and spring unit could be fitted, less advantageously, above and between the frame sections.

The present invention will now be further described, by way of example, with reference to the accompanying drawings, in which:-

*Figure 1* is a side view of a preferred embodiment of a motorcycle incorporating a rear suspension according to the present invention;

*Figure 2* is a front, perspective view of the motorcycle of *Figure 1*;

*Figure 3* is a rear, perspective view of the motorcycle frame of *Figures 1* and *2*; and

Figure 4 is a perspective view of the rear suspension shock absorber unit used in the motorcycle of Figures 1 and 2.

The motorcycle illustrated in Figures 1 and 2 of the accompanying drawings has a frame or chassis comprising a rear swing arm 1 which is pivotally connected at 3 to a main frame 5. The rear spring arm 1 and the main frame 5 are each individually moulded from carbon fibre, this being preferred for its relative simplicity of manufacture and weight saving. However, for the purposes of the present invention which relates to the motorcycle rear suspension, the frame i.e. main frame and rear swing arm, can alternatively be of conventional tubular construction.

The main frame 5 (as best seen in Figure 3), is generally V-shaped and carries the front forks 7 for the front wheel 9. The V-shape main frame 5 also rigidly carries the engine 11 which is slung between the arms of the V-shaped and under the main frame 5. Two brackets 13 are provided on the underside of the engine 11 and a shock absorber and spring unit, generally designated 15, is pivotally mounted at 17 on these brackets 13. The shock absorber and spring unit 15 is of the push-pull type wherein the shock absorber has a piston rod 19 which projects out of both ends of the shock absorber body 21 (see Figure 4). A spring 23 is located over one end region of the piston rod 19 and can be compressed between the end 25 of the piston rod 19 and the shock absorber body 21, by pulling on the other end region. This other end region of the piston rod 19 is pivotally attached to the rear swing arm 1 at 27, point 27 being spaced from pivot point 3, but lying between pivot points 17 and 3 taken in a plane transverse to the parallel axis of these pivot points 3, 17, 27. By this arrangement of the pivot points 3, 17, 27, and the shock absorber and spring unit 15, as a load is applied to the motorcycle frame e.g. extra luggage or rough terrain, so the main frame 5 and rear swing arm 1 pivot about 3, pulling on piston rod 19 to compress spring 23; shock absorber body 21 restricting the return movement in a desired manner. Considering two imaginary lines, one drawn between pivot points 3 and 27, and the other drawn between pivot points 17 and 27, as the load on the motorcycle frame increases so the angle between these two lines moves towards 90°. Thus as the load increases, so the mechanical advantage i.e. lever ratio, between the rear wheel i.e. rear swing arm 1, and the shock absorber and spring unit 15 increases. As previously explained, this increase in mechanical advantage is highly desirable to provide an optimum ride irrespective of the conditions.

In the preferred embodiment described hereabove, the shock absorber and spring unit 15 is slung under the engine 11, thus keeping the centre of gravity of the motorcycle as low as possible. This is clearly desirable. However, within the limits of the present invention, the shock absorber and spring unit could be equally well (as far as the suspension alone is concerned) located above and between the main frame 5 and the rear swing arm 1.

As evident from Figure 3, the rear swing arm 1 in the illustrated preferred embodiment of the present

invention, is also generally V-shaped, with the apex of the V-shaped pivoted at 3 between the arms of the V-shaped main frame 5, the rear wheel 29 being pivotally mounted between the arms of the V-shaped rear swing arm 1.

Thus the present invention provides a relatively simple rear suspension for a motorcycle, which is therefore more convenient to manufacture than equivalent known rear suspensions with a progressive spring rate increase feature. Further, there is clearly a reduction in overall weight, this being enhanced if the present invention is used with a carbon fibre frame as per the illustrated preferred embodiment. Still further, the centre of gravity of the machine can be kept as low as possible by slinging the suspension unit 15 under the engine 11. Finally, the space availability problem for previous progressively increasing spring rate suspensions, is obviated by the simple construction of the present invention.

#### CLAIMS

1. A motorcycle rear suspension for a motorcycle having a frame comprising a rear swing arm which carries the rear wheel of the motorcycle, the rear swing arm being pivotally attached to a further part of the frame, the rear suspension comprising a shock absorber and spring unit which is fixedly mounted relative to said further part of the frame so as to be pivoted about its middle region, one end region of the shock absorber and spring unit being pivotally secured to the rear swing arm at a point spaced from the pivotal connection between the rear swing arm and said further part of the motorcycle frame.

2. A motorcycle rear suspension as claimed in claim 1, in which the shock absorber and spring unit is an integral assembly with the shock absorber being of the pull-push type wherein the piston rod passes completely through the unit.

3. A motorcycle rear suspension as claimed in claim 2, in which the spring is mounted on one projecting end region of the piston rod and is compressible between the body of the shock absorber and the free end of said one end region of the piston rod, the other projecting end region of the piston rod being pivotally connected to the rear swing arm.

4. A motorcycle rear suspension as claimed in any one of claims 1 to 3, in which the frame is constructed as a tubular frame.

5. A motorcycle suspension as claimed in any one of claims 1 to 3, in which the frame is fabricated from the metal sheet.

6. A motorcycle rear suspension as claimed in any one of claims 1 to 3, in which the rear swing arm and the said further part of the frame, are moulded from carbon fibre.

7. A motorcycle rear suspension as claimed in claim 6, in which the motorcycle engine is secured to said further part of the frame, and the shock absorber and spring unit is pivotally secured to the engine.

8. A motorcycle rear suspension as claimed in claim 7, in which the shock absorber and spring unit

is mounted under the engine.

9. A motorcycle rear suspension constructed and arranged substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

---

Printed in the UK for HMSO, D8818935, 11/84, 7102.  
Published by The Patent Office, 25 Southampton Buildings, London,  
WC2A 1AY, from which copies may be obtained.